THE ECONOMICS OF DAIRY PRODUCTION

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Abstract

Farm profitability is influenced by financial, real estate, macroeconomic variables, and industry-specific factors. Gross profit in dairy farming, determined by marketed milk and variable costs, reflects the difference between milk revenue and production costs. Effective management requires continuous assessment of each animal's performance to improve herd productivity and economic efficiency. Benchmarks are essential for decision-making and project management, significantly impacting profitability. Farmers can increase profitability by reducing costs or boosting milk production, requiring thorough economic analysis. Effective strategies include cost minimization, asset utilization, milk marketing, and production expansion. Larger farms benefit from economies of scale, while small farmers must innovate to remain competitive. Net profit, or profit per cow, is a key profitability metric. Effective feeding management and constant awareness of feed and milk prices are crucial. Tracking gross milk income and feed costs provides a more accurate measure of profitability. Various metrics like accounting profit, net farm income, and return on assets (ROA) offer insights into farm financial success, with ROA being useful for comparing different-sized farms. Dairy farm profitability relies on a multifaceted approach, including animal performance monitoring, cost management, and market responsiveness. Leveraging technological advancements and efficient management practices enhances profitability and ensures sustainability.

Keywords: *dairy production, economics, dairy profitability*
JEL: *Q13, Q14, Q18, Q19*

Introduction

In 2020, the Hungarian agriculture accounted for 4.1% of GDP. Looking at our history, the agricultural sector, including dairy and feed production played an importantant role (Obrusányszki, 2011), and today is of huge importance, not only for domestic consumption but also for export activities. Despite this, the number of farms in Hungary has been steadily declining since 2010, with the majority of farms engaged in crop production and the minority in livestock farming (www.ksh.hu 2020).

Demand and supply of production were greatly affected by the change of regime and the accession to the European Union. As a result of joining the EU, deteriorating profitability and the need to meet strict quality standards led to a decline in domestic milk production. Nevertheless, globalisation, openness and adaptation to the EU was a necessary and inevitable event. The effects of international agricultural policy have had a negative impact on the production of milk and dairy products in Hungary, due to wider market opportunities and cheaper imports. Although the volume of products that can be exported has increased greatly, the same is true of those that can be imported. This became most noticeable after the abolition of the milk quota, when overproduction on the international market allowed for greater substitution of more expensive Hungarian products with cheaper foreign ones (Vásáry, 2017).

The ability of farms to produce earnings, or their viability, is influenced by a variety of financial, real estate, and macroeconomic variables, as well as by fundamental industry drivers and the

specific technical and economic traits of each farm (Popescu, 2009, 507-513). Meanwhile gross product, which includes marketed milk, culled cows, calf, and waste, as well as variable costs, which include replenishing heifer, cow, and calf, food, water, power, medications, and veterinarian services, directly affect gross profit (Popescu, 2009, 507-513). Profit, used as a gauge of economic performance in dairy farming, is calculated as the differential between milk revenue and total milk production costs (Varian, 1992). Profit could be viewed as a function of milk output and input rates, taking into consideration that the cost of producing milk is dependent on a variety of agricultural inputs (Ahmad et al. 2013, 94-97).

In order for dairy farms to be profitable, it is important for them to have an overview of how each animal is performing, whether it is worth it to keep them for one more lactation, is their milk yield as much as the rest of the cows, how breedable are they or whether their health is worse then the rests. Early-developing traits enable earlier decision-making, which reduces the time that unproductive animals remain in the group as well as the reproduction gap.

In order to guarantee economic efficiency, benchmarks have become crucial instruments assisting farmers with project administration and decision-making. It can be difficult for producers to determine the most effective benchmarks based on a variety of partial measures of efficiency, such as milk output per cow, milk sold per worker, or expenses per unit of milk made (Ferrazza et al, 2020, 49). These benchmarks can either directly or tangentially impact other variables, such as profitability (Solís, Bravo-Ureta and Quiroga, 2009, 202-219). Profitability is one of the most important key factors for farms, when it comes to decision making, as the farm needs to make enough money to cover opportunity costs, or at the very least to cover the loss of possible gains from other alternatives when one alternative is selected, in order to remain in business (McKean, 2005).

Dairy businesses can become more profitable by either cutting expenses or producing more milk. Farmers lose money when the price at which milk is sold does not equal the overall cost of producing milk. The foundation for identifying opportunities to reduce milk production costs and boost profits to convert dairy farming into a viable business is economic study of the industry (Bhowmik, Sirohi, 2008, 303-307).

Research goals

The primary goal of this research is to conduct a comprehensive literature review and data analysis to identify the major cost components of dairy farms and analyze their cost structure in relation to farm profitability. Additionally, the study aims to examine the cash flow trends of Hungarian dairy farms between 2007 and 2023 and assess the relationship between milk production costs, market prices, and overall farm profitability during the same period. Specifically, the research seeks to:

- Identify the largest and most significant cost components of dairy farms based on existing literature and evaluate their impact on profitability.
- Analyze the cost structure of dairy farms, examining the proportion of various expenses (e.g., feed, labor, veterinary costs, machinery) and their role in determining financial success.
- Examine the production cost of milk in Hungary between 2007 and 2023, identifying key cost drivers.

– Analyze the market price of milk in Hungary over the same period and compare it to production costs to determine profitability trends and economic sustainability.

By addressing these questions, the research aims to provide a clearer understanding of the economic sustainability of dairy farms and identify key factors influencing profitability over time.

Materials and method

This research is based on extensive literature analysis to identify key factors influencing the cost structure and profitability of dairy farms. A comprehensive review of relevant studies, reports, and academic publications was conducted to synthesize existing knowledge and establish a theoretical framework for the analysis. Additionally, publicly available data from the Institute of Agricultural Economics (AKI) was utilized to create original figures and visual representations of cost trends and production expenses. These figures were systematically analyzed to assess the financial dynamics of dairy farming, providing insights into long-term economic patterns. By combining primary research through literature review with quantitative data analysis, this study offers a well-rounded perspective on the economic challenges faced by dairy farms.

Literature review

Management

The modern farmer must be an adept manager, choosing various business ventures to engage in in order to maximize profit while concurrently completely developing human capital and adhering to environmental protection laws (Bewley, 2010). Farmers must be able to adapt to changes in the economic climate and continuously be conscious of their environment's changing conditions in order to remain competitive. Only after conducting a thorough study of agricultural indicators can effective management strategies be put into practice (Ramsbottom et al, 2015,3526-3540). In order to maximize revenue and profit, dairy farmers use a variety of management techniques, such as: (1) cost minimization to increase profit; (2) asset minimization per production unit to reduce fixed costs; (3) milk marketing to obtain the best milk price; and (4) production expansion. Given the limited time and resources available to managers, it is challenging to balance asset utilization with cost cutting, production maximization, and milk marketing in order to generate net revenue. Therefore, it is crucial for managers to decide how to best use their limited management time.

Kingwell R. (2011, 12-34) demonstrated that even for highly trained managers, profitable farming systems are frequently vast, intricate, technologically advanced, and involve time-consuming operations. Financial outcomes, which are influenced by strategic decisions about continuing development or, in certain cases, ceasing operations, are determined by farm productivity, which is produced from production technology that is properly adapted to given conditions (Bragg and Dalton, 2004, 3092-3098). Improvements in the input-output ratio and income growth based on increased production capacity can both help farms become more profitable and work toward competitive agricultural systems (Tey and Brindal, 2015, 15).

Measuring profitability

Like other economic pursuits, the fiscal viability of milk output is assessed using the indicator of net profit. Having a clear grasp of how each cow affects farm revenue can help with dairy farm administration (Scott and DeLorenzo, 1988, 3092-3098). A common belief is that production efficiency, as measured by the number of pounds of milk sold per cow, is a good predictor of managerial skill and has a significant bearing on profitability. Numerous research have revealed a correlation between cow milk output and different financial performance metrics.

The price volatility of completed goods as well as changes in feedstock prices, which account for the largest portion of expenditures, have an impact on farm profitability. Low milk output, imbalanced feed ratios, and little forage space are characteristics of low-performing farms. The size of the farm and agricultural profitability are significantly associated. This is because larger farms can spread fixed expenses across more animals because of the scale of economies, which lowers the price per cow and allows for smaller profit margins (MacDonald, Cessna and Mosheim, 2016). As they use superior equipment and are more specialized in production, large farms have greater turnover rates and are more productive (Kryszak, Guth and Czyzewski, 2021, 90-100). On the other side, due to their weak bargaining position, small farmers must adapt their business model and increase their capacity for innovation in order to compete more effectively on the market (Dervillé and Allaire, 2014, 347-360).

Aside from some quality component flexibility and maybe a volume premium, the vast bulk of farm milk production can be considered a commodity in that an individual farmer has little influence over the price paid and simply accepts what the market is giving. Dairy farmers primarily use cost reduction in a commodities market to boost profits (Wolf, 2003, 271-293).

Measuring profitability is essential for evaluating the financial success of dairy operations. A typical metric is net income, or profit per cow, which accounts for the money made from the selling of milk and other products after deducting production expenses. In order to use such calculation, it is very important to know the prices of feed and milk at all times. The effectiveness of feeding, which is connected to the achieved milk output, also affects the profitability of dairy farms (Barham, Brock and Foltz, 2006, 16). The price volatility of completed goods as well as changes in feedstock prices, which account for the largest portion of expenditures, have an impact on farm profitability (Buza et al, 2014, 3073-3080). Because of the ongoing changes in the milk and feed markets, as well as the fluctuating costs of gasoline, fertilizers, and crop seeds, it can be challenging to forecast a dairy producer's income.

Although other variables can be used to quantify farm profitability, Jonathan et al, employs return on assets (ROA), which is defined below, as it has been found to be one of the most useful metrics for evaluating dairy profitability across farms in this context. ROA is an indicator that is used to solve the shortcomings of traditional farm profitability metrics like net farm income. Because ROA is a relative metric that enables researchers to compare farms of various sizes, numbers of operators, and funding, it is frequently preferred as a measure of profitability (Gloy, Hyde and LaDue, 2002, 233-247).

Throughout decades of research, there were four main measures found on a variety of profitability measures. The first one is by Dratt et al. (1999, 2412-2420), which is the accounting profit. Total revenue minus total expenses gives the accounting profit. It helps equalize disparate agricultural standards and does not assign an arbitrary monetary value to unpaid expenses (labor, management, and financing interests).

The second one is net farm income. After cash income is adjusted for changes in inventory, net farm income is calculated as total accrual revenue less total accrual expenses (labor, management,

and financing interests) (El-Osta and Johnson, 1998). According to Lins et al. (1987, 53-61), this measure is suitable for examining the degree to which farm profits are produced through the application of labor, management, and capital.

The third, helpful economic model for dairy production profit maximization was created by Gloy, Hyde, and Leduc (2002, 233-247). According to their concept, farm assets and farmer management determine farm profitability, and their variation among farms determines the variation in profitability. Thus, it is vital to take into consideration variations in farm size, farm management, input costs, and milk price in order to identify the factors causing variation in profitability between farms.

Last, but not least, the rate of return on assets: net farm revenue is reduced by unpaid labor and management costs, interest expense is added, and the capital return is divided by the entire amount of assets. According to Dratt et al. (1998, 2412-2420), this measure eliminates variations in farm size and costs related to labor, management, and financing.

Feed efficiency

In a lot of the work on dairy profitability, feeding management factors are frequently included as independent variables. As feed costs are the biggest expenses on dairy farms, it has been demonstrated that the management of feed has a considerable impact on both total expenses and net revenues. Improved feed grain was closely connected with both improved milk output per cow and increased profitability (Hardie et al, 2014, 4612-4623). This is a helpful variable when assessing feeding management strategies because greater grain feeding frequently results in a higher milk production per cow.

In order to forecast profitability, farmers should focus on profit margins rather than milk income or feed costs. As increased milk production results in increased milk revenue, milk output is frequently tracked. When feed prices are high, however, tracking gross milk income per cow alone may not give a reliable indication of cash flow or profitability. By incorporating gross milk income and feed costs, Wolf (2010, 4942-4948) demonstrated how income over feed cost (IOFC) may be utilized to track profit.

Technology and innovation

Determining the most important costs and factors of milk production is a key factor in order to being able to have a proper overview of how farms' productivity work. Cabrera et al. (2010, 387-393) discusses findings, focusing on the impact of common dairy farming practices in the United States, particularly the effects of intensification on farm performance. Using a Structural Production Function (SPF) model and analyzing 273 Wisconsin dairy farms, the study aimed to identify determinants of Total Efficiency (TE) in traditional dairy regions. Results highlighted that the number of cows on the farm had the most significant impact on production levels, followed by expenditures in crops, feeding, livestock, and labor.

Surprisingly, there was no proportional relationship between farm size and output, indicating that productivity improvements rely more on technology and efficiency than farm size. These insights contribute to our understanding of dairy farm dynamics, especially in traditional dairy states like Wisconsin.

External factors

Each geographical region's dairy farms have a number of traits that have a significant impact on the structure of the dairy business. Climate, agronomic circumstances, population density, and milk pricing are some of these traits. Herd size is impacted by climate through housing and shelter needs related to temperature and precipitation. Agronomic factors affect cropping patterns, which in turn affects the quantity and kind of feed produced locally or on-farm for dairy animals. A related factor is that the opportunity cost of agricultural land is determined by agronomic factors. Pasture may be the optimal use of land for a wide range of relative values depending on the terrain and environment (Wolf, 2003, 271-293).

Results

The expenses of feeding, labor, health, milking, and breeding—which together make up the EOC—as well as the depreciation of upgrades, machinery, and equipment, as well as family labor, are included in the total operating cost (TOC). High TOC is hence one of the factors contributing to the economic inefficiency of dairy farms. Indeed, the excessive use of debt capital was noted as a potential factor explaining the inefficiency of dairy farms when taking into account the economic inputs and outputs (Mor and Sharma, 2012, 85-91). These findings demonstrate that, in order to reduce production costs, managerial and technological efforts should be made to maximize technical efficiency and address process flaws and inefficiencies.

These findings demonstrate that, in order to reduce production costs, managerial and technological efforts should be made to maximize technical efficiency and address process flaws and inefficiencies. In a study that examined 963 businesses spread over Brazil, Alves et al. (Alves, Souza and Brandão, 2001, 27-36) verified this theory and found that, in the majority of samples (74%), resource misallocation significantly contributed to negative net income. Comparably, Cabrera et al. (2010, 387-393) found that Wisconsin dairy farms had poor technical efficiency (88%) and recommended utilizing the level of inputs and technologies currently in use in the region to improve.

Feed

For dairy production, feed expenses have always made up almost half of the variable costs. Recent prolonged low milk prices and increased public awareness about the impact of dairy production on climate change through greenhouse gas emissions have increased the significance of further advances in feed efficiency (FE) (De Haas et al, 2017. 855-870).

Labor

Agriculture is still a labor-intensive industry, and most human resources working on farms are family members. It is believed that a larger household will be able to overcome labor shortages and provide cost-effective worker input. It follows that a higher probability is positively correlated with household size (Tey and Brindal, 2015, 15). Farm profit margin is directly impacted by input costs, whether they are specifically tied to worker employment or not (Dratt et al, 1999, 2412-

2420). In terms of workforce spending, paying employees for longer hours requires more farm revenue. As a result, farm productivity is reduced. However, additional analysis conducted for the same study showed that working hours had no effect on financial output. The higher output could offset the higher labor expenses because longer workdays need more work in the farming process. This highlights yet another weakness in agricultural enterprise management abilities: a competent manager will only cover increased labor expenditures to the extent that doing so will increase enterprise profitability (Tey and Brindal, 2015, 15).

Animal Health

It was primirarly discovered that the most prevalent illnesses, mastitis and lameness, were the primary reasons for production losses (Stott, Coffey and Brotherstone, 2005, 41-52).

Mastitis-related health issues, movement disorders (such as lameness and issues with the feet and legs), and infertility (which includes postpartum disease and issues with reproduction) are the three primary causes of dairy cow culling (Smith, Ely and Chapa, 2000, 2980-2987). Over roughly two decades starting in the mid-1980s, the risk for reproductive and udder-related disorders has stayed stable, whereas the annual incidence risk of dairy cow culling due to low production has declined (Compton et al, 2017, 1-16). Farmers suffer financial losses as a result of the prevention and treatment of these health issues, which significantly compromise the wellbeing of the animals (Inchaisri et al, 2010, 835-846). These expenses include a significant portion of veterinary and insemination costs, the proportion of which to total farm expenses varying based on the animals' condition (van Soest et al, 2016, 9365-9374).

According to Stankov's (2020, 375-378) estimation, the profit margin from healthy cows was found to be 8.4–21.2% larger than that of cows with illnesses. When it came time to cull, cows with clinical mastitis had shorter lifespans overall and in terms of productivity. Both Huijps et al. 2008, 113-120) and Pfützner and Ózsvári (2017, 110-115) calculated the economic impact of subclinical mastitis and came to the conclusion that it has a detrimental influence on the financial results of farms.

Lameness prevalence was linked to farmer expenses, according to a number of studies. Additionally, lameness was reported to have detrimental effects on longevity, cumulative milk output, and milk production by and Puerto et al. (2021, 7944-7955).

Conflicting results

While existing research provides valuable insights into dairy farm profitability, findings across studies are not always consistent. Several factors contribute to these discrepancies, including variations in methodology, geographic differences, and differences in farm management strategies. A critical analysis of the literature reveals three key areas where conflicting results and gaps emerge.

The first one is the role of the farm's size in profitability. Many studies suggest that larger farms benefit from economies of scale, leading to lower production costs per unit and higher profitability (MacDonald, Cessna, & Mosheim, 2016). However, other research highlights that small and medium-sized farms can remain competitive through niche marketing, direct sales, and improved management efficiency (Dervillé & Allaire, 2014). These conflicting conclusions indicate that size alone is not the sole determinant of profitability; rather, management decisions, feed efficiency, and market conditions play equally significant roles. Further research is needed to examine how

non-traditional business models, such as cooperative farming or precision dairy technology, impact small farm sustainability.

The second one is the relationship between feed efficiency and profitability. The literature agrees that feed costs represent the largest expense in dairy production (Buza et al., 2014), but studies differ in their assessment of how feed efficiency translates into profitability. Some studies argue that increased grain feeding leads to higher milk yields and greater profits (Hardie et al., 2014), while others suggest that high feed costs can erode potential gains, particularly in volatile market conditions (Wolf, 2010). The effectiveness of different feeding strategies may depend on region-specific factors such as climate, feed availability, and regulatory constraints. This suggests the need for further research into regionally adapted feed optimization models.

Last, but not least, different studies use varying metrics to assess profitability, leading to inconsistencies in reported findings. Some research prioritizes net farm income as the best profitability indicator (El-Osta & Johnson, 1998), while others argue that return on assets (ROA) provides a more accurate measure, as it accounts for differences in farm size and structure (Gloy, Hyde, & LaDue, 2002). Additionally, some studies emphasize income over feed costs (IOFC) as a real-time profitability tracker, given that feed expenses are the largest variable cost (Wolf, 2010). These methodological differences highlight the need for standardized profitability metrics that allow for better cross-study comparisons.

Cost structure of Hungarian dairy farms

Production costs are a key determinant of the economic sustainability of dairy farms, as they directly impact profitability and operational efficiency. These costs include essential expenses such as feed, labor, energy, veterinary services, and equipment, all of which contribute to the overall financial burden on producers. Among these, feed costs often represent the largest expenditure, making dairy farms particularly sensitive to fluctuations in input prices. Managing production costs effectively is crucial for maintaining farm viability, as rising expenses can put significant financial pressure on producers.

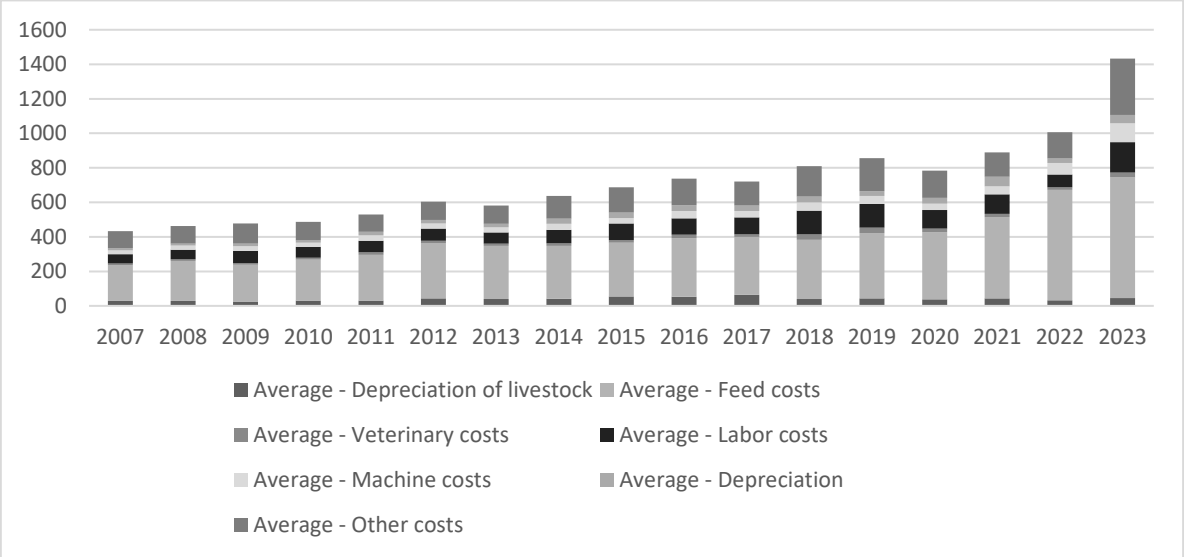

Figure 1: Cost structure of Hungarian dairy farms

Source: AKI, own editing, 2025

As figure 1 shows, the cost structure of Hungarian dairy farms has undergone significant changes between 2007 and 2023, with a clear upward trend in overall production expenses. Throughout the examined period, costs have steadily increased, reflecting rising input prices, inflation, and external economic pressures. A temporary decline in costs was observed in 2020. However, by 2023, costs had surged significantly, indicating persistent financial challenges for dairy producers.

Among all cost components, feed costs consistently represented the highest expense throughout the entire period. This trend underscores the crucial role of feed in dairy production and its sensitivity to price fluctuations. Given that feed accounts for a substantial proportion of total costs, any increase in grain, forage, or supplementary feed prices could have a direct and profound impact on overall farm profitability.

The cost escalation seen in 2023 suggests that Hungarian dairy farms are facing mounting financial pressures, necessitating strategic cost management and efficiency improvements. Future research should further examine the underlying drivers of cost increases, particularly in feed prices, and explore potential mitigation strategies to enhance the economic sustainability of dairy farming in Hungary.

Cost of milk production and it's selling price

The relationship between production cost and selling price is a crucial factor in determining the profitability and sustainability of dairy farms. Production costs include a wide range of expenses, such as feed, labor, energy, veterinary care, and equipment, all of which directly influence the financial viability of milk production. On the other hand, the selling price of milk is shaped by market demand, global trade dynamics, regulatory policies, and input cost fluctuations. When production costs rise faster than selling prices, dairy farmers face economic challenges, whereas a favorable price-cost ratio can improve profitability.

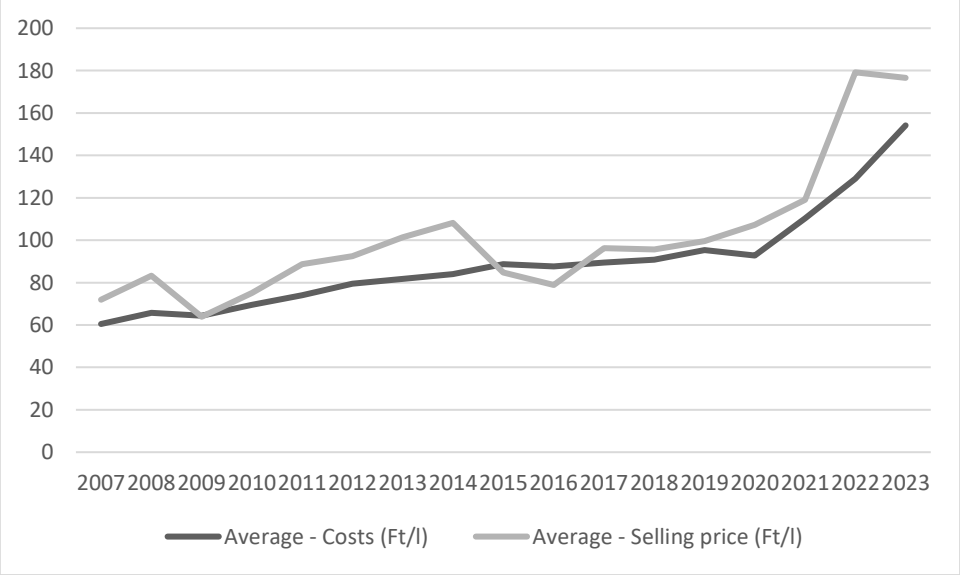

Figure 2: Cost of milk production and it's selling price

Source: AKI, own editing, 2025

As figure 2 shows, the relationship between milk production costs and selling prices in Hungary between 2007 and 2023 reveals significant economic trends that have impacted dairy farm profitability. Throughout the examined period, production costs exhibited a continuous upward trend, driven by increasing feed prices, labor costs, energy expenses, and other input factors. The highest production costs were recorded in 2022, marking the peak of the 17-year period.

Similarly, milk selling prices also showed an overall increase, reflecting inflation, market demand, and global dairy price trends. However, an important anomaly can be observed around 2015–2016, when production costs exceeded the selling price. This period presented significant financial difficulties for dairy farmers, as they faced negative profit margins, making it unsustainable to cover expenses solely from milk sales.

Although the selling price of milk has generally kept pace with rising costs, the continuous increase in production expenses—especially feed costs—remains a critical concern for dairy farm profitability. The record-high production costs in 2022 suggest that Hungarian dairy farms are under growing financial pressure, requiring efficiency improvements and potential policy support to ensure long-term sustainability.

Research gaps

Despite the extensive analysis of Hungarian dairy farm profitability and cost structures, several research gaps remain that warrant further investigation. One significant limitation is the lack of farm-level data and profitability metrics. While macroeconomic trends in costs and prices are well documented, there is limited research on how individual farms manage financial pressures. More microeconomic case studies would provide deeper insights into farm-specific adaptation strategies and financial resilience.

The relationship between production costs, farmgate prices, and retail prices also presents an important research gap. Although trends in milk prices and costs are analyzed, the role of market structures, supply chains, and dairy processors in price transmission is not well understood. Examining these factors could provide valuable insights into how pricing dynamics affect farm profitability.

Finally, there is a lack of research on long-term strategies for improving cost efficiency. While studies highlight the continuous rise in production costs, few explore effective solutions for mitigating these increases. Future research should focus on the role of technological innovations, automation, and alternative feeding strategies in optimizing dairy farm expenses.

Addressing these research gaps would contribute to a more comprehensive understanding of the economic challenges facing dairy farms and help develop strategies for ensuring their long-term financial sustainability.

Conclusion

This study provides a comprehensive analysis of the economic factors influencing dairy farm profitability, focusing on cost structures and the relationship between production costs and milk prices. The findings highlight the significant role of feed costs as the dominant expense, the increasing financial pressures on dairy farmers due to rising input costs, and the challenges posed by fluctuating milk prices. The research also underscores the importance of effective farm management strategies, technological advancements, and policy interventions in ensuring long-term economic sustainability.

Despite the observed trends, profitability remains highly dependent on external market conditions, cost-efficiency measures, and the ability of farms to adapt to economic fluctuations. Future research should further explore farm-level financial data, the impact of subsidies, and innovative cost-management practices to provide deeper insights into sustainable dairy farming. Addressing these challenges is essential for maintaining the competitiveness and viability of the dairy sector in an evolving global market.

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